The Process of Installing a Coral Reef Early Warning System (CREWS) Station

The CREWS Program is part of the

Integrated Coral Observing Network

and the Coral Health and Monitoring Program at the

Atlantic Oceanographic and Meteorological Laboratory

National Oceanic and Atmospheric Administration

Miami, Florida

For further information, please contact Dr. Jim Hendee:

Jim.Hendee@noaa.gov

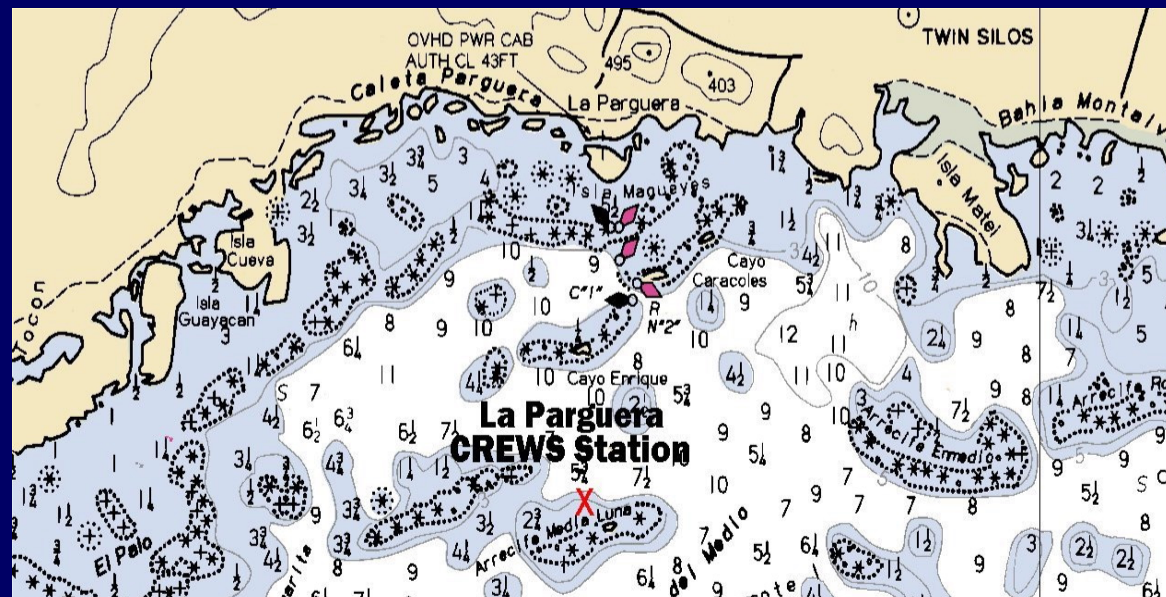
A Coral Reef Early Warning System (CREWS) station is an in situ meteorological and oceanographic monitoring station. The stations are being installed to meet goals outlined by the U.S. Coral Reef Task Force and NOAA.

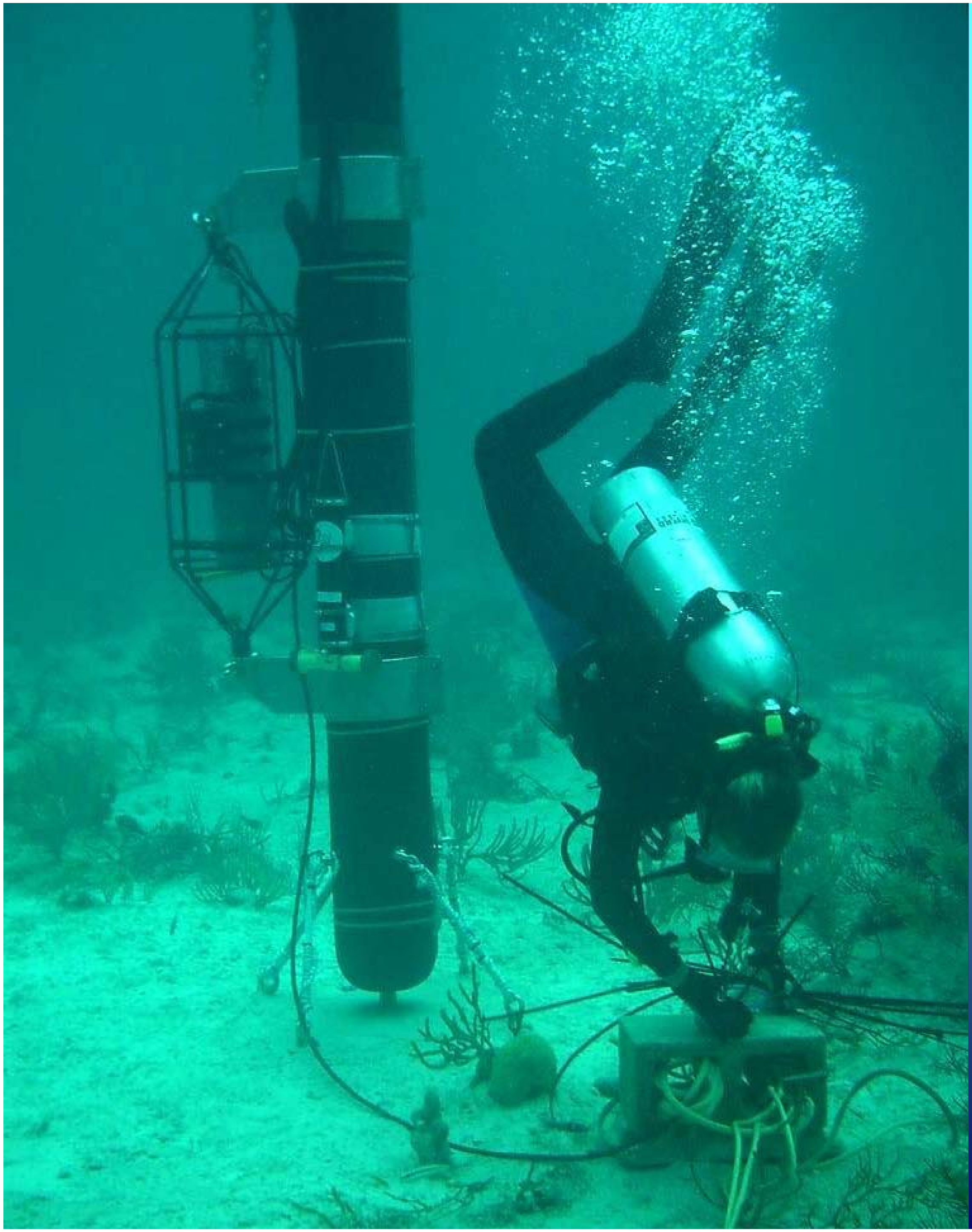
The typical instruments contained on the station include those for measuring wind speeds and gust, air temperature, barometric pressure, precipitation, relative humidity, photosynthetically available radiation above and below the water, ultraviolet light above and below the water, sea temperature, and salinity.

The stations are typically maintained every ten days to two weeks to reduce biofouling, and to test measurements against known standards ("ground-truthing").

The CREWS Station at Media Luna Reef, in SW Puerto Rico.

CREWS stations, such as this one in SW Puerto Rico, in the La Parguera Marine Reserve, provide long-term hourly databases to, a) provide Marine Protected Area decision support, and, b) define long-term trends for research analyses in the areas where they are deployed.





The Instruments

A stable pylon-style coral monitoring platform provides the opportunity to position instruments of various sizes, shapes and configurations at various heights above the ocean and depths throughout the water column.

Meteorological instruments measure air temperature, wind speed, barometric pressure, humidity, precipitation and light (PAR, UV).

The basic oceanographic instruments measure sea temperature, salinity and light (PAR, UV). Optional instruments measure pCO2, Pulse Amplitude Modulating (PAM) fluorometry, and transmissometery. New instrumentation may record nutrients, acoustic signals from fish and plankton, or particle counts.

To begin the process of installing a CREWS station, a hard bottom area strong enough, and at the right depth (20'), must first be chosen.

Debris is cleaned out from an old dead coral site in preparation for installing the stainless steel bottom plate.

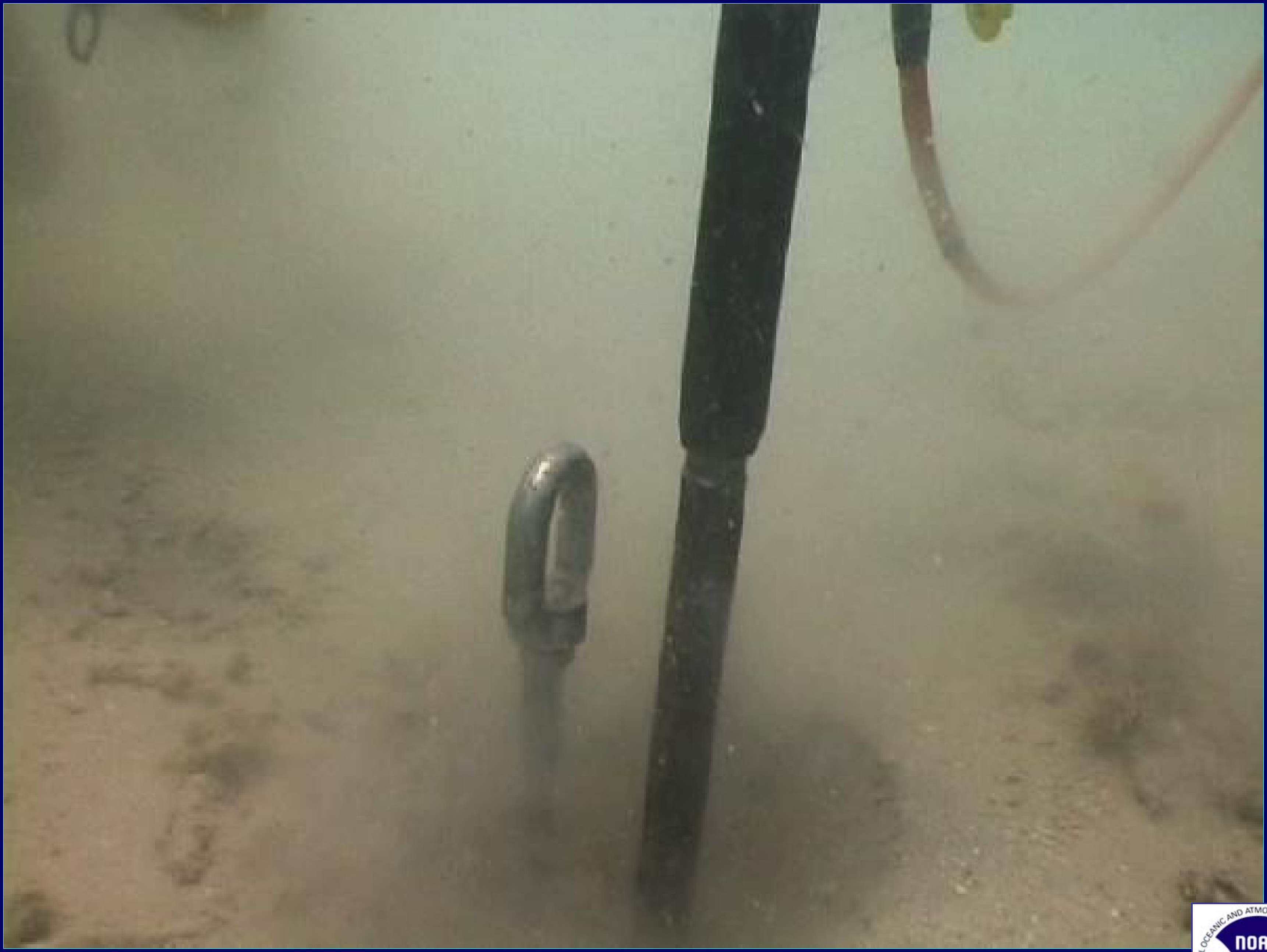
PVC pipe is used to mark the location for the stainless steel holes to hold down the plate.

Concrete is poured to support the stainless steel plate and pylon, with spaces allowed for stainless steel pins to be installed next.

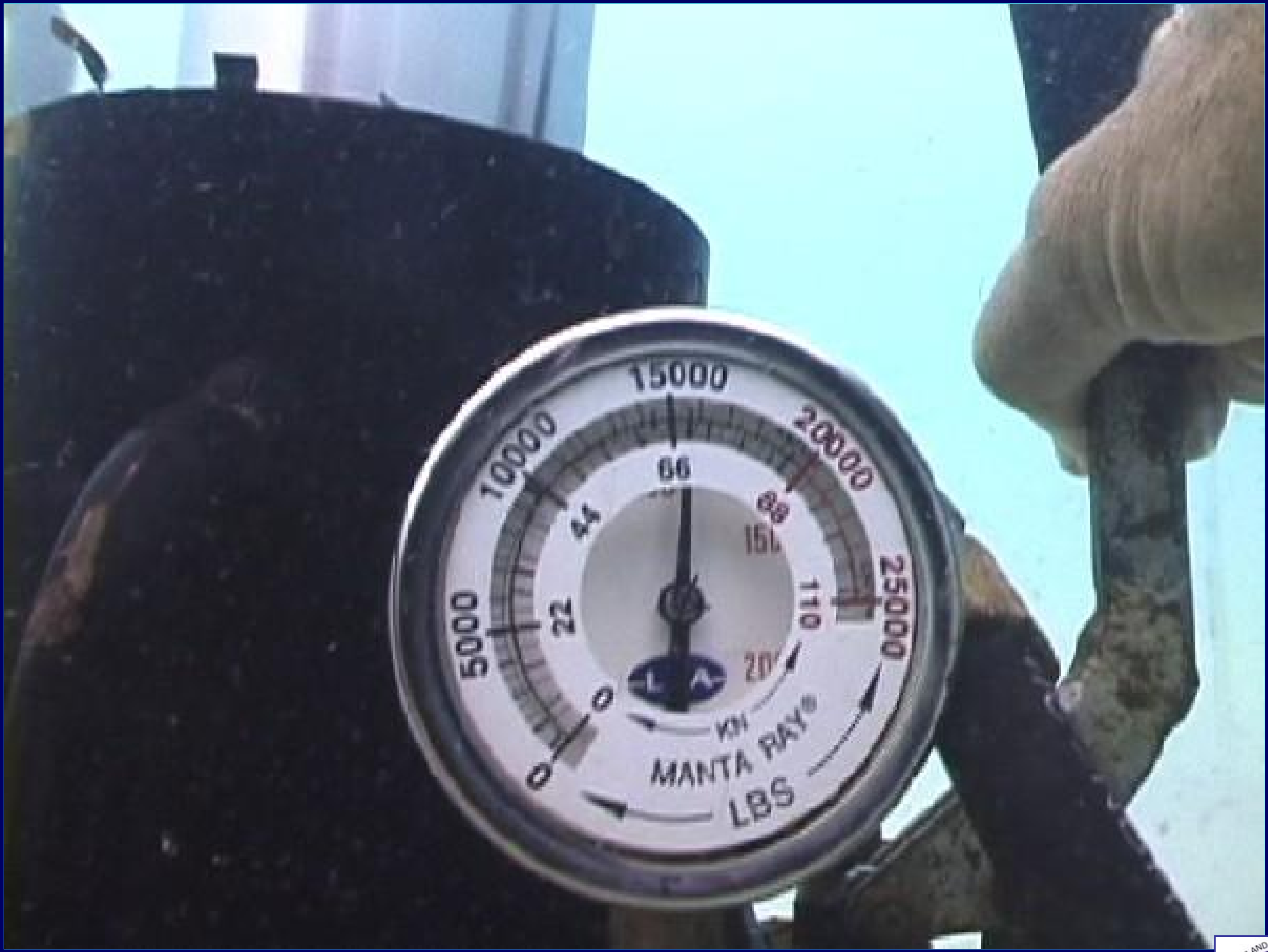
The bottom plate is deployed over the top of the concrete and fastened down with the stainless steel pins/eyes.

Note the stainless steel ball which will support the entire pylon in a ball-and-socket type of fit.

Holes are drilled in the sandy areas for installation of the manta-ray anchors.



The manta-ray anchors will hold the stays that keep the station supported upright.



The load strength of the manta-rays is tested to ensure that they can hold at least 15K lbs tensile strength.

The manta-rays are buried eight feet in the sand to ensure stability and strength.

This is the 38' long pylon just before installation. Note that it is only 10" in diameter.

The station is held up straight in the water with eight Spectra cord/chain combinations, which act as shock-absorbers for the station during inclemency.

The CREWS crew discusses the tricky issues of installation: it can be challenging because of all the forces, equipment and heavy chains in play, and safety is paramount.

The station is moved from the barge to the water, where it will be towed by skiff.

Care is made that the navigational light does not dip into the water during towing.

A diver attaches "pillow bags" to keep the pylon afloat in the proper orientation. After the station is towed to the spot of deployment, the bags will be slowly deflated so that the pylon is lowered gently to the region of the bottom plate, while the divers steer the socket joint on the bottom of the pylon into place over the stainless steel ball on the plate.

The pylon is finally on its way to the installation site. The pylon must be towed slowly in calm seas.

Divers make ready to install the station at the bottom plate site.

The station is fastened to the bottom plate by the divers.

The underwater "shock absorber" lines are attached by divers to the station during the process of straightening up the pylon.

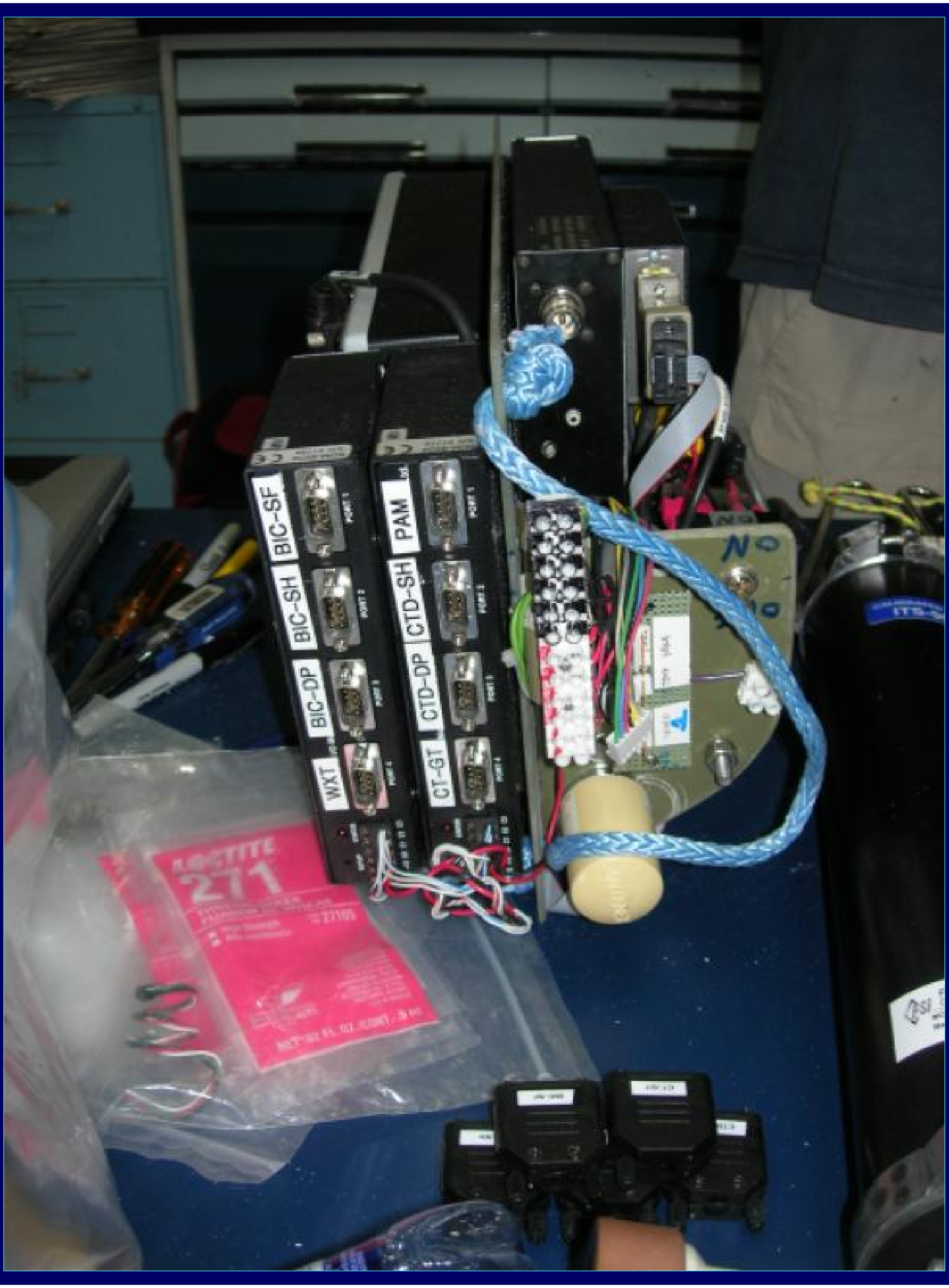
The divers utilize lift bags, which they inflate and deflate, to help tension and adjust the supporting lines alternatively, until the pylon is standing up straight. The bags are also utilized to lift the heavy chains and move them into place. NOAA must use specially trained NOAA Working Divers to conduct these special underwater construction-related tasks.

A NOAA Working Diver adjusts tension on a supporting line before tying it off securely.

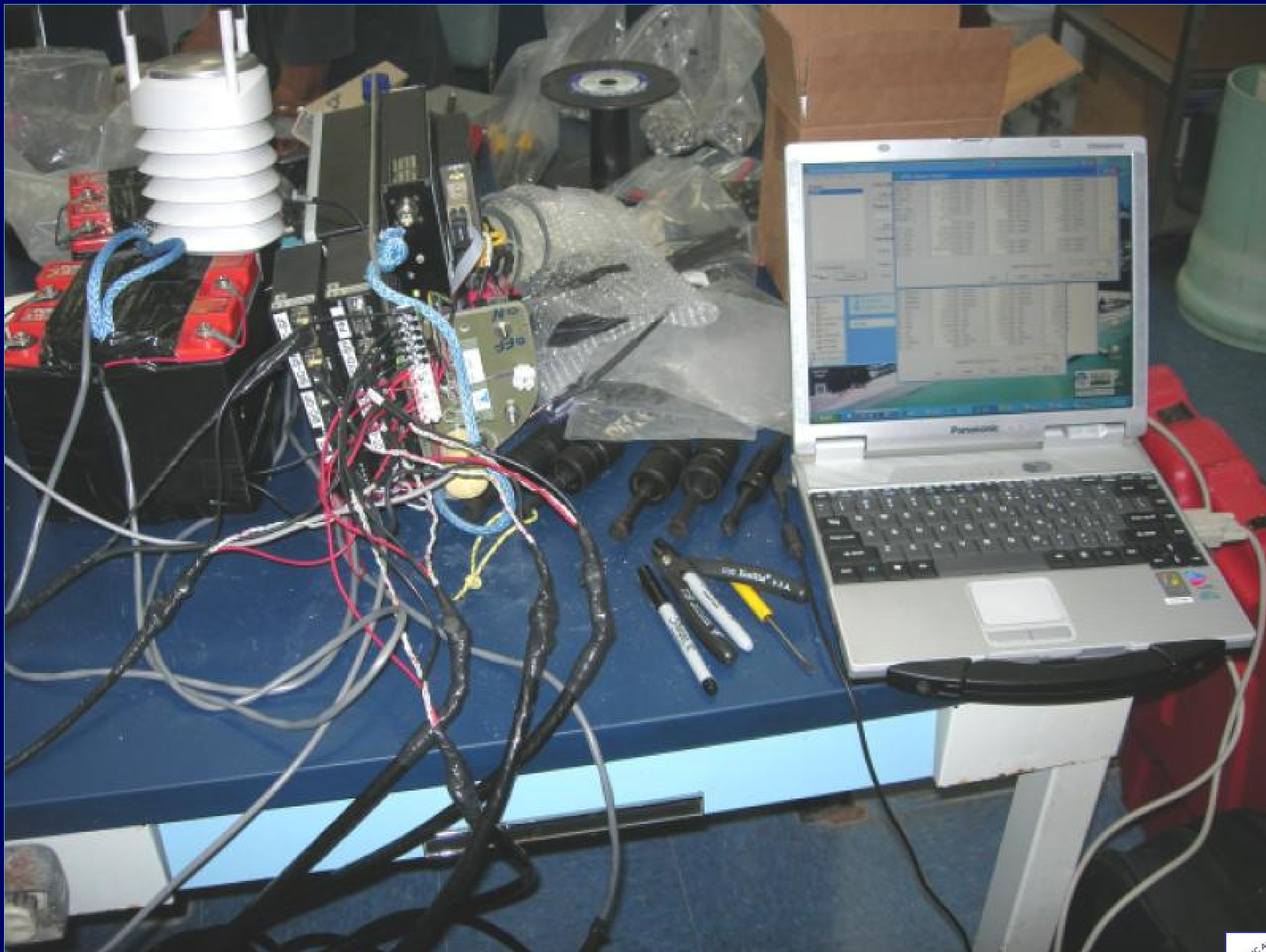
Finally, the pylon is straight and the pillow bags can be deflated so that the pylon can now stand on its own through its eight supporting lines. The bare pylon is now ready for the addition of the electronics.

During the next phase, the CREWS crew begins by unpacking the electronics in preparation for testing.

The data logger is fitted with the input sensor cables for testing.



The basic list of sensors connected to the data logger include those designed to measure wind speed, wind gust, precipitation, barometric pressure, relative humidity, light (above and below the water), sea temperature, and salinity. Each sensor "talks" to the data logger in a different fashion and must be programmed to acquire the data from the sensor several (or many) times per hour before assessing the average value which it will send up to the GOES satellite once per hour.



The data logger is tested with a laptop computer for data throughput before deployment.

The logger, batteries and other electronics are installed inside the station from the top.

The solar-powered battery pack sits beneath the data logger and has enough amp-hours to last for long cloudy periods.

Meanwhile, the divers install the CTDs and light sensors underwater while the cables are pulled from the top.   The divers must adjust the light sensors for maximum exposure to the sun, and the CTDs must be installed at 1 m below the surface and 1 m above the bottom.

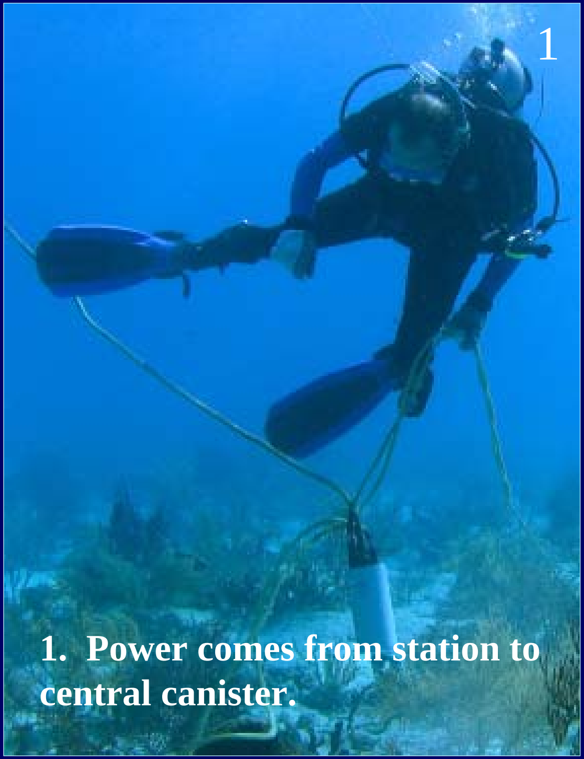
The next 12 hour day at the station begins before dawn. The installation and testing of the electronics is a long process.

The crew in the skiff hoists the meteorological and data transmission instruments to the man aloft, who will then attach them to special grounded supports. Note the lightening arrestor (brush) positioned at the highest point on the station.

Just below the lightening arrestor is a platform that holds the navigation light, which can be seen up to about 3.2 nm away. This light has its own power supply and automatically changes bulbs when one goes out. Thus, the CREWS stations act as navigational markers, and in fact have saved lives in the past during heavy storms when mariners were lost at sea.

The electrical system is tested by the programmer one more time with all instruments attached. After the instruments are attached, the GOES transmitter is tested to see if it has adequate transmission power, and the logger is double-checked to make sure it is polling the instruments correctly, and that the numbers being transmitted appear to be realistic.

Solar panels are installed on all sides because of the varying angle of the sun in the tropics during the year. The panels supply power to the batteries through a charge controller, and the batteries supply power to the data logger, the GOES satellite transmitter, the GPS unit, and the meteorological and oceanographic instruments.

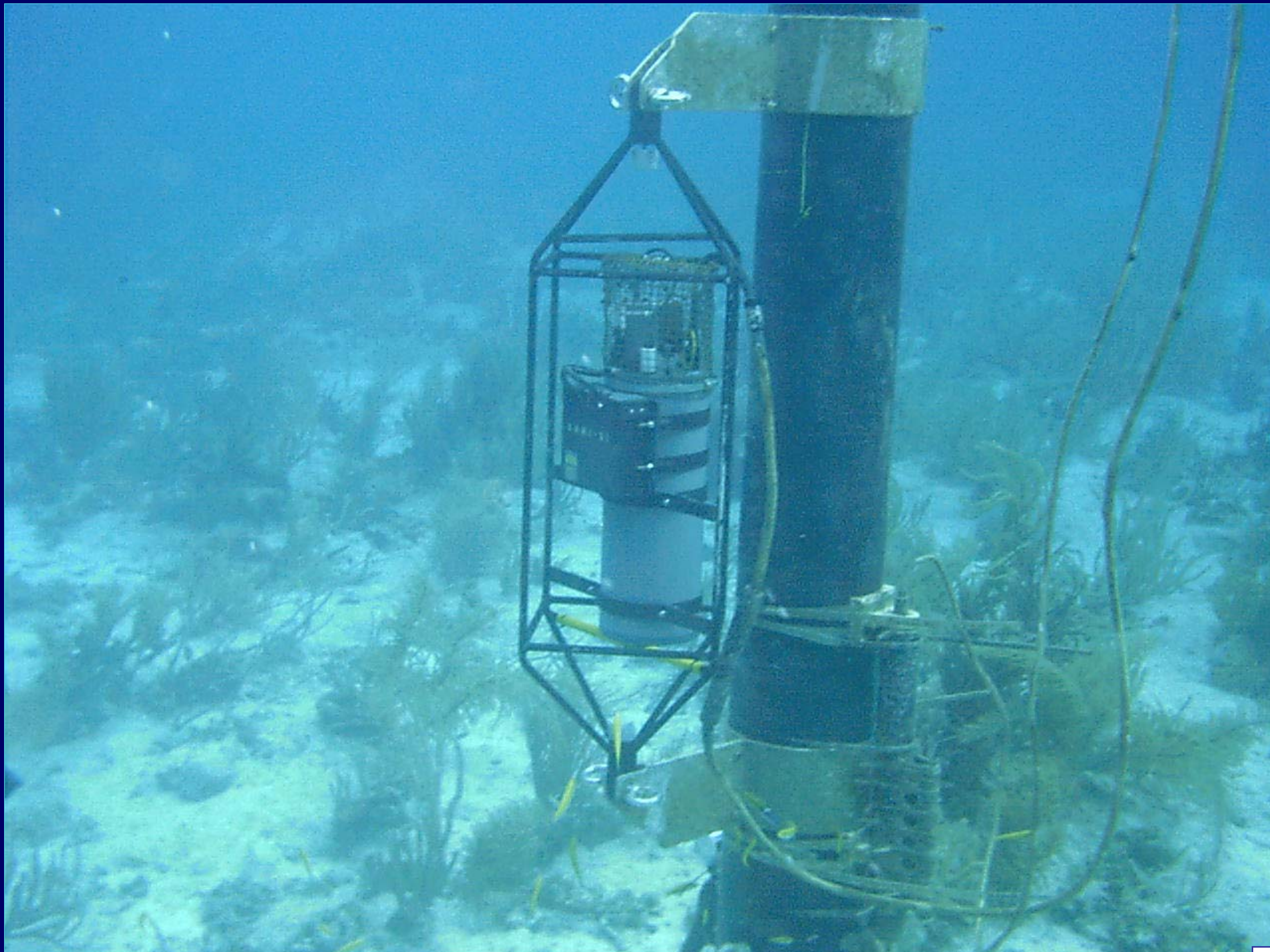


1. Power comes from station to central canister.

2. Divers position PAM-fluorometer stand.

3. Diver positions PAM-fluorometer head precisely.

Additional research instrumentation may be added to the basic instrument suite, depending upon the interests of collaborating scientists. Here, a team of divers and scientists deploys a Pulse Amplitude Modulating fluorometer for coral bleaching studies.



Another research instrument being utilized measures the partial pressure of carbon dioxide, and will help determine the role of CO2 in coral growth under a changing climate